CLOTHING, AND ITS RELATION TO HEALTH AND DISEASE.

A LECTURE

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It is a trite and true saying that "Prevention is better than cure." Nevertheless, it is nearly always as to cure, and not at all about prevention, that a doctor is consulted.

Now, the lectures delivered under the auspices of the Manchester and Salford Sanitary Association, although generally given by members of the medical profession, are all intended to show how disease may be prevented, and not how it may be cured. If, however, we can enlighten you as to the causes of disease, and incite you to use every endeavour to prevent its occurrence, you will need less curing, and so relieve the medical profession very considerably. We have medical officers of health, who are appointed chiefly to prevent disease attacking the community, and we hope that as regards the residents in and around Manchester, at least as many of them as hear the sanitary lectures which are delivered from year to year, or studiously read them when published, will each become his own medical officer of health; and, as a consequence, I prophesy that such residents will see much less of their medical officer of disease. Did you ever think of the health which the lower animals, especially in a wild state, enjoy, compared with the disease and death of the human race? Have you ever tried to account for the great difference observed? It is, no doubt, to be explained, in a great measure, by the fact that man is a naked and a rational animal. The lower animals are born ready clothed, and they have instinct to guide them in choosing the quality, as well as the quantity, of food which their systems require. Man, on the other hand, is born without clothing, and is left, when grown up, to cloth himself, and to eat and drink according to his judgment; and no one can deny that it is by errors in clothing, in eating, and in drinking, that a very large percentage of our

diseases are produced. Cowper seems to have been impressed with this when he wrote the following verse :—

"Reasoning at every step he treads,
Man yet mistakes his way ;
While meaner things, whom instinct leads,
Are rarely known to stray."

The science of preventive medicine is yet in its infancy, and very little has hitherto been written on the subject of clothing. As clothes are intended to cover the skin, I must first explain its structure and functions, before you can understand what I have to say as to clothing.

Structure of the Skin.—The skin consists of the cutis vera. or corium, and the cuticle, or epidermis. The *cuticle*, which consists of flattened cells, forms a protective covering over every part of the true skin ; and when cast off, as it frequently is, in large pieces, after scarlet fever, we find on its under surface an exact cast of the upper surface of the true skin. The cuticle contains neither nerves nor blood-vessels, and so it is devoid of sensibility, and does not bleed when injured. It varies greatly in thickness in different individuals, and on different parts of the body. Compare the hand of the labourer with the hand which is never engaged in any manual labour, and you will see a difference in the cuticle ; or compare the skin of the ill-clothed child with one which is well clothed, and you will find that nature has done her best to make up for the mother's neglect or caprice, by causing a great increase of the cuticle over those parts most exposed to the weather. It in some cases becomes so thick and hard that it cracks, and exposes the true skin underneath. The *true skin* is essentially a nervous and vascular tissue. It is divided into two layers, the reticular and papillary. The *papillary* is the upper layer, and is divided, as its name implies, into papillæ, which are small eminences, composed chiefly of blood-vessels and nerves. These vessels and nerves are so numerous and closely packed that you cannot prick the true skin without causing pain and letting blood. The nerves, besides endowing the skin with feeling, act on the blood-vessels in the papillæ and cause them to dilate, as when we blush, or to contract, as when pale from cold or fear. When the blood-vessels are dilated they contain more blood than when contracted, and so expose a larger quantity of blood to the cooling influence of the air. The *reticular* layer of the true skin contains in its meshes hair follicles, glands, and fat. Between the true skin and the muscles there is a layer of fat, varying, as you all know, in different individuals. In the lower layer of the true skin, and in the sub-cutaneous fat, glands are found

named sebaceous, ceruminous, and odoriferous, which have reference chiefly to the protection of the skin, or to some other local purpose. The glands of most importance to us are those which form the sweat, and are called sweat glands. They are seated in the sub-cutaneous fat, and the duct or tube which conveys the sweat to the surface of the skin passes upwards somewhat like a cork-screw, and opens obliquely on the surface of the cuticle. It has been calculated that as many as 3,528 of these glands exist on a square inch of the surface of the palm of the hand; and since every tube, when straigthened, is a quarter of an inch in length, it follows that in such a square inch there exists a length of tube equal to 882 inches, or 73½ feet. Further calculation shows that the total number of pores of the body may be about 7,000,000, and the length of the perspiratory tubing about 1,570,000 inches, or nearly twenty-eight miles.

These statements may give you some idea of the vast importance of perspiration, or sweating; and I hope you will bear in mind the sketch I have given you of the structure of the skin while we now proceed to consider its function.

Function of the Skin.—Each organ of our bodies has a special function to perform. Thus, if we consider the process of digestion, by which our bodies are nourished, we shall find that of the food which enters the stomach, part is absorbed and goes in the blood to nourish the tissues. The arterial blood going from the heart carries the food for the tissues; the veins which bring the blood to the heart again contain venous blood, *i.e.*, blood which is full of the waste products of the tissues of the body. These waste products must be removed from the blood, and it must be purified before it is again sent into the system. This purification is carried on by various organs taking from it the particular ingredients they are intended to remove. Thus we have bile from the liver, urine from the kidneys, carbonic acid and water from the lungs, and sweat from the skin. Although each of these organs has its special function to perform, nevertheless, one can assist another in case of need. Thus it is found that when the kidney is diseased, and fails to take from the blood what a healthy kidney takes, the skin in sweat, and the lungs in the breath, carry off the products which ought to pass out of the system by the kidney. Again, when the liver is at fault, and cannot remove the bile, we find that the kidneys and skin help to pass it out of the system, and so we get jaundice. An organ, however, may perform its duty perfectly, but some obstruction may exist, so that its secretion cannot pass out of it. In this case the secretion is again absorbed into the blood and causes disease. What, then, are the special functions of the skin?

1. One great function of the skin is to purify the blood by removing impurities from it in the form of sweat. When you remember that the length of the perspiratory tubing is twenty-eight miles you will not be astonished to learn that the exhalation from the skin is probably greater than the excretions of the bowels and kidneys combined. In warm and cold weather the skin and kidneys alternate in the proportion of work they perform, most passing off by the skin in warm, and by the kidneys in cold weather. What I have said relates only to insensible perspiration. The perspiration caused by great heat, or severe exercise, is evolved in much greater quantity, and by accumulating at the surface it becomes visible. In this way a robust man engaged in hard labour, and exposed to intense heat, may lose five pounds weight in the course of an hour. I shall never forget a sight I saw in ascending the Rigi, a high mountain in Switzerland, on a very hot day. The mere effort of climbing as slowly as possible made me perspire most uncomfortably. But I saw a man carrying a sack of flour on his back, up to the hotel on the mountain top; and, as he climbed, the sweat poured from the point of his nose to the ground in a continuous stream. You may imagine the change which such a journey would effect in a man's tissues. Taking the lowest estimate, we may consider the skin endowed with the important charge of removing from the system about twenty ounces of waste matter every twenty-four hours. We may thus understand how checked perspiration proves so detrimental to health, because for every twenty-four hours during which such a state continues we must either have a large amount of useless and now poisonous matter accumulating in the system, or have some of the other organs greatly overtasked to get rid of it. We may also understand the danger of extensive burns, since we know what a quantity of nerves the skin contains, and how important is its function as an exhalant. You will also see the necessity there is to keep our skin clean, so that its secretion may not be retained, nor in any way impeded in its flow.

2. Another function which the skin performs is the regulation of the temperature of the body. Here we must again digress to consider how the heat of the body is produced, and to learn a few facts regarding it which it is necessary you should know, that you may, without difficulty, understand what has to follow. To explain how the body heat is produced, I cannot do better than ask you to compare the body to a steam engine. The stomach and digestive system will then represent the fire in the engine. Food enters the stomach, coals are put into the fire, and both are burned, though in different ways. The food generates heat in the body, as fire does in the boiler. The force generated by the heat of the

fire causes motion in the engine, and the friction of the parts of the engine on each other causes more heat. And so it is in the body. The various movements and processes which go on in the body, apart from the primary burning of our food, cause heat; and it may help you to remember this fact if you think of it as somewhat similiar to the heat produced by friction in an engine. In our bodies this heat is generated by what may be called our secondary digestion, *i.e.*, the digestion which each cell performs upon the nourishment in the blood which it finds suitable to repair its waste and keep it in proper working order. You will thus understand that less heat is produced when the body is at perfect rest, as when asleep, than when it is awake and active. You will also understand how it is that one feels colder driving in a carriage than when walking, or riding on horseback.

Now, although there may be other causes of the heat of our bodies, these are sufficient for our present purpose, and I shall now give you a few facts as to the natural heat of the human body. It has been calculated that the chemical processes going on in an adult in the space of twenty-four hours produce about 12,000 caloric units. A caloric unit means that amount of heat which is required to raise the temperature of one pound of water one degree Fahrenheit. The heat produced by one person in one day would heat 7⅓ gallons of water from freezing to boiling point, *i.e.*, from 32° to 212° F. But the amount of heat generated by our bodies varies greatly. It varies with the quantity of food, and with the amount of exercise we have, and this variation may amount to as much as 50 per cent of the whole quantity. When the body is producing little heat, you would expect its temperature to be lower than when it is producing a great deal, but it is not so. Neither does the temperature of the body vary to any appreciable extent when exposed to the excessive heat of the equator, or the terrible frost of the arctic regions. Who could imagine the human body to be of the same heat in an atmosphere with a temperature of 104° as in one 84° below the freezing point? And yet, so it is. How, then, does man's body retain the same temperature to whatever quarter of the globe business or pleasure may lead him? Here again we must digress, to understand fully the answer to that question. We have learned how our bodily heat is produced, and now it is necessary to know how it is lost. To this end we must consider ourselves as warm and moist bodies, surrounded by a cooler atmosphere. Such bodies may be said to lose their heat in four ways—

1. By Radiation.
2. By Evaporation.
3. By Conduction.
4. By Convection.

1. *Radiation.*—It is by radiation that a hot body heats a cold one, at a distance from it. Thus, it is by radiation that the sun heats our earth. It is by radiation that we feel the heat from a red-hot ball of iron when we put our hand or face near enough to it. Radiation is always going on, so long as there is any difference of temperature between two bodies; and the greater the difference of temperature the stronger is the radiation. Thus, in newly kindling a fire in a room, in the depth of winter, it takes some time before the room feels comfortable—not, indeed, until the walls get properly heated, because, when their temperature is low, they absorb the heat which is passing from the fire, as well as that which passes from our bodies, by radiation. If you enter an ice cave you feel cold, because the heat is leaving your body by radiation, and you may witness its effect on the ice, by seeing water—that is, melted ice—dropping from the roof. But radiation can be lessened by putting something round the hot body, so as to intercept the heat. Thus a "cosy" is put on the teapot to prevent the heat leaving the tea through the teapot, and I suppose most of you are aware how well it fulfils that intention.

2. *Evaporation* is the second process by which we lose heat. When a liquid is changed into a gas it is said to be evaporated, and during this process the liquid extracts heat from the surface on which it lies. We may understand the value of this process in cooling the body, seeing that it requires 2¼ caloric units to change fifteen drops of water into vapour. The evaporation of perspiration is constantly going on, whether we notice it or not, and so the body is constantly being cooled. By experiment upon man, at rest and at work, it has been found that on a day of rest about two pounds of water is evaporated through the lungs and skin during twenty-four hours, and on a day of hard work four and a quarter pounds. In the first instance about 2,016 caloric units, in the second 4,480, had to leave the body in consequence of evaporation. Whenever, therefore, we are perspiring, we are losing heat by the evaporation of the perspiration, and although our skin is moist we are actually cooler than when it was dry. The more we sweat the cooler we get.

3. *Conduction* is the third process by which we lose heat. If we put one end of a bar of iron into the fire, and leave it in for some time, the heat will pass, by conduction, along the bar until the other end is too hot to be touched. If instead of a metal bar we use a glass rod, the further end of it will never get very hot, because glass is a bad conductor—iron being a good one. When you touch a good conductor it feels cold, although it has exactly the same temperature as other things, because it conducts the heat

quickly out of your hand. You all know how much warmer blankets feel than sheets, simply because the material of which sheets are made is the better conductor. And you will now understand that if we wish to keep ourselves warm we must cover our bodies with material which is a bad conductor. Wool, hair, and feathers are bad conductors of heat, and that is the reason why such substances have been provided by nature as clothing for animals.

4. *Convection* is the last of the processes by which we lose heat. It is the process by which liquids and gases are heated. They would never get properly heated by conduction, as a bar of iron does. Heated air and heated water are lighter than cold air or cold water; and so as one layer of air or water gets heated it ascends, and its place is taken by a cold layer, which is again displaced in its turn, and so on, till the whole air or water is heated. That process is called convection, and by it our bodies are constantly being cooled. You must all be familiar with the current which a jet of gas causes up towards the ceiling. Each of us in a still room, just like the jet of gas, causes an upward current of air, which a small instrument, called the anemometer, would show if it were placed between the coat and waistcoat. This current is formed by the air around us being heated by our bodies, and so rendered lighter. When standing still, the current of hot air rising from our feet surrounds the whole body, so that the lower will lose more heat than the upper parts of the body, having a colder air coming in contact with them. If we sit down we shall lose more heat by convection than when we were standing, because the heated air from the legs will pass up without coming over the trunk. If we lie down we shall lose more heat by convection than when standing or sitting, because the air, as soon as heated by any part of the body, passes off the body almost immediately; and this is one reason why, when lying down, we are so apt to take cold. Water acts in exactly the same way in cooling our bodies, but as its temperature is generally lower than that of the atmosphere, it abstracts heat from the body more quickly.

The naked body, then, as it stands erect, is constantly losing heat by radiation into the atmosphere, by the evaporation of perspiration, by convection into the air, and by conduction into the ground through the soles of the feet; but there is a system of nerves, entirely beyond the control of our will, which so acts on the blood-vessels and glands of the skin that when heat is going off quicker than it is being formed the blood-vessels are caused to contract, so as to expose less blood on the surface, thus diminishing

the heat lost by radiation and convection, while at the same time the nerves diminish the amount of perspiration being formed, and so lessen the heat lost through evaporation. The skin, if the loss of heat be moderate, can preserve the proper temperature of the body without help, and those who endeavour to harden themselves or their children, by exposing a large surface of the body to the air, and by taking them out in all sorts of wind and weather in this country, are merely trying to exercise to its utmost limit the heat-regulating power of the skin, a practice which is the cause of an inconceivable amount of disease and very many deaths, especially amongst children. I do not mean to say that children cannot be reared under this hardening idea, but I know how frequently such children suffer from bronchitis, and how many die. When nature is thus relied upon by mothers, she tries to help herself by making the cuticle thicker, as I mentioned before, and you may find the skin on the legs and arms of some much-exposed children approaching in roughness the hide of a pig. Now I should think most people would prefer to assist nature by proper clothing, and so preserve the appearance of the child's skin, apart altogether from the question of health.

Here it seems necessary that I should say something of the state of the atmosphere as affecting the heat of the body. The rate at which the body loses heat varies according to the temperature and moisture of the atmosphere, as well as according to its rate of movement. A low temperature, of course, cools the body quicker than a high one. A dry hot atmosphere is better than a dry moist one for cooling the body, seeing that a moist atmosphere lessens the amount of evaporation from the skin, as well as the amount of moisture that passes by the lungs. If we consider the loss of heat which takes place by respiration in different states of the atmosphere you will understand this better. In twenty-four hours the quantity of air taken into the lungs is 2,000 gallons. It has been calculated that by the process of respiration a person loses—

1,172 caloric units when air is 32° and quite dry;
1,116 ,, ,, ,, and half saturated;
1,060 ,, ,, ,, and saturated—

that is, when it holds as much moisture as it can take up. The difference between the two extremes is very slight. But when the temperature is 86°, instead of 32°, the above numbers would be respectively 1,096, 760, and 420, in which the extremes vary considerably. For instance, if the atmosphere is at freezing point, it matters little how the moisture of the air is, but at 86° it matters very much, for if it is moist at 86° we cannot get quit of our heat,

and feel oppressed, whereas if the air is dry we lose it much more quickly, and feel comfortable.

A comparison of the losses of heat by breathing an absolutely dry air and an absolutely saturated air, at 86° and 32°, is highly instructive.

At 32°, and dry, we lose 1,172 caloric units.
At 86° „ „ 1,096 „

Difference..... 76

At 32°, and saturated, we lose 1,060 caloric units.
At 86° „ „ 420 „

Difference 640

The difference in the state of dryness of the air thus appears to be of greater importance than the difference of temperature, and this is the reason why our sensations do not always agree with the thermometer. Our southerly winds are warm and moist, our northerly cold and dry; our westerly winds moist, and our easterly dry. Who does not know the dreaded east wind, which not only causes disease in man, but sometimes shrivels up vegetation as if a scorching fire had passed over the country? All winds arise from changes occurring either in the temperature or in the humidity of the air. If two neighbouring regions come, from any cause, to be of very unequal temperature, the air of the warmer region, being lighter than the other, will ascend, while the heavier air of the colder region will flow in below to supply its place, so causing a wind. Again, if the atmosphere of one region be more highly charged with aqueous vapour than the atmosphere of surrounding regions, the air of the more humid atmosphere, being lighter, will on that account ascend, while the heavier air of the drier regions will flow in below and take its place. Now we lose less heat by our skin when standing still than when being moved quickly through the air, and so you will understand why we lose heat more quickly on a windy day than on a day when there is no wind, because the wind carries away the heat. We feel cold on a calm frosty night, but if a strong wind rises we feel colder still. Thus you will see that in clothing ourselves we must take into account not only the temperature and humidity, but also the rate of movement of the atmosphere.

After this long but necessary introduction, I now approach the proper subject of the lecture, viz., "Clothing and its Relation to Health and Disease."

From what you have now heard as to the functions of the skin,

and from what you know by experience of our climate, none of you can suppose that clothes are worn merely for the sake of morality, or to decorate our bodies. You will now understand that clothes are our weapons of defence against the sudden and great changes in the weather. You will also understand why the natives of countries near the equator wear little or no clothing, whereas the natives of regions near the poles clothe themselves so thoroughly. As was said before, the lower animals have the advantage over us in being born clothed; and as they are clothed by the Creator it may not be amiss for us to consider their clothing, and ascertain in what its perfection consists. If, then, we observe the animals around us, we find that whether their clothing consists of hair, wool, or feathers, they are completely covered; and we also find that as the warm season approaches the coat becomes thinner, while with the approach of winter it again grows thick and long. From such observations, if from no other source, we may learn (1) to cover the whole body, except the hands and face, with clothing; (2) to have it warmer in winter than in summer; and (3) to have it light in weight and fitting comfortably, so as not to interfere with the free movement or function of any part of the body.

Let us take fur, a common covering of the animals around us, and consider its value in keeping them warm. Fur consists of hair and skin, between which there is little difference chemically. The weight or body of the skin is much greater than that of the hair, and yet it is to the hair that the fur owes most of its value as a protection against cold. Dr. Kreiger has made some experiments by covering a cylinder full of warm water with shorn and unshorn fur. The cylinder will lose heat, and the water cool, more or less quickly, as the nature of its covering varies. Taking the loss of heat through the entire fur as 100, he found that it rose to 190 when the same piece of fur was used shorn, showing that the shorn fur allowed nearly twice as much heat to pass through it as the unshorn fur. A dried skin is always somewhat porous, and in order to see the effect of shutting up the pores he gave it a coat of linseed-oil varnish, when the loss of heat rose to 258—that is, a dried skin allows a loss of heat equal to 190, but a dry skin varnished allows a loss of 258. This explains the old observation that furred animals cannot live which have had their skin shorn and oiled or varnished. Their death used to be explained by the suppression of the evaporation from the skin, but it can now be proved that even in a comfortably warm room these animals literally freeze to death, so quickly does the heat leave their bodies.

How, then, is the hair of the fur so valuable in retaining the heat of the body? A fur is so arranged that its fine hair, projecting into the air, intercepts all the heat which flows from the surface by radiation, and distributes it through the air which circulates between the single hair cylinders. The finer the hair of the fur, the more of the outgoing heat is taken up by the air, which, however low the temperature of the atmosphere may be, reaches the nerves of the skin as a warmed air. The point at which the temperature of the body and the air equalise each other moves between the roots and the points of the hair, being close to the skin in very cold, and at the points of the hair in very warm, weather. When the points of the hair have the temperature of the surrounding atmosphere, no heat comes to the surface for radiation, therefore it is only by convection that the animal loses heat; and this explains why extreme cold can be borne when the air is calm, but scarcely so when there is a high wind. We thus learn that the fur of animals preserves the heat of the body, by keeping a layer of warm air continually around the skin, or, in other words, removing the place at which the heat of the body and the temperature of the atmosphere equalise each other from the surface of the skin to some distance from it.

Such are the qualities of a perfect clothing; and the nearer our clothing imitates the fur of the animal the better shall we be protected against changes in the weather. It is evident that we cannot separate the hair from the skin of the animal and put it on our skin as it was on that of the animal, and if we could, we would not. Instead of that we take the wool of sheep, with other animal and vegetable products, and weave them into fabrics, with which to cover our bodies. Experience and custom have led us to clothe ourselves as we are now clothed; but so little attention has the subject of clothing received from science that very few facts are known as to the value of different kinds of materials in helping us to preserve or get quit of our bodily heat. What we want for clothing our bodies is some light material which is a bad conductor of heat, and at the same time will allow free ventilation of the surface of our skin.

First, then, as to the conducting power of clothing. It must be a bad conductor, so as to store up in itself the heat that leaves the body, and thus transfer the point from which our heat radiates from the surface of the skin to the outside of the clothing, or to some point in its substance. Experiments have proved that material made of silk or cotton allows more heat to pass through it than material made of wool; and so the woollen

material is better than silk or cotton as clothing. Again, it has been proved that any material when on the stretch, by being tightly drawn, allows more heat to pass through it than when it is loose; and, further, it has been found that by leaving some space, say from ⅓ to ½ an inch, between two layers of the same material, it lessens very considerably the outward flow of heat. This space of from ⅓ to ½ an inch may be taken to represent the space between comfortably fitting garments; and therefore we learn that to draw our clothes tightly round the body is to deprive them of a large proportion of their power of preserving our heat; and so if we wear our clothes tight we shall require more of them to keep ourselves warm than if they fitted more loosely. In proof of this I may call your attention to the effect of tight gloves and boots upon the hands and feet in winter, of which I feel sure every one will know something.

It matters little what colour our clothing is, so far as its conducting power is concerned, but colour is of great importance when our clothing is exposed to luminous heat, *e.g.*, to the heat of the sun. Different colours absorb heat very differently, while different materials of the same colour show very slight differences in their powers of absorption.

For white textures the following proportions have been found—

When Cotton received	.....	100
Linen „	.....	98
Flannel „	.....	102
Silk „	.....	108

With shirtings of different colours the proportions were—

White received	.....	100
Dark yellow „	.....	140
Dark green „	.....	168
Light blue „	.....	198
Black „	.....	208

Everyone knows that dressed in black one feels hotter in the sun than when dressed in white, and the reason, as we have seen, is because black takes up more heat than white. Light-coloured clothes, then, are best for summer, and black clothes for winter wear.

Secondly, our clothing must allow free ventilation of the skin. This may seem contrary to your ideas, for clothing is generally considered necessary to keep the air from us, whereas it has been proved by experiment that those clothes which allow

most air to pass through them keep us warmest. Taking the quantity of air passing through flannel as 100—

Linen	allowed.....	58 parts of air.
Silk	„	40 „
Buckskin	„	58 „
Kid	„	1 „
Chamois	„	51 „

to pass through them. If our clothing kept us warm in proportion to its power of excluding air from the body, kid would keep us a hundred times warmer than flannel, while every one knows by experience that it is quite the reverse. Successive layers of the same material have very little influence in diminishing the ventilation, so that while we use several layers of woollen clothes to prevent radiation, we do not interfere with the proper ventilation of the skin. It is by interfering with such ventilation that waterproof fabrics are so unpleasant and dangerous to wear.

There is another point which it is necessary to consider as regards our clothing, viz., the effect which water has upon it. It is evident that all textures lose their ventilating and increase their conducting power, more or less, when wet. Linen, cotton, and silk soon become air-tight by wetting, whereas flannel becomes so only after a long soaking. This explains why we feel so much colder, and take cold more readily, with a wet linen than with a wet flannel shirt next to the skin.

It is evident, then, that so far as we know at present woollen fabrics are those which are best suited for underclothing, in this climate, where such sudden changes overtake us; and, as a general and leading principle, we conclude that the whole body should be covered with flannel, varying in thickness as the seasons may require. In summer the flannel should be thin, that it may not lessen our heat loss so much as to make us uncomfortable; still we must wear it to protect the skin against the sudden changes of the weather to which, even in summer, in this country, we are exposed.

This seems a fitting time to give you an example of the way in which disease may be originated. Suppose that you go, in good health, to a crowded meeting, or to a badly-ventilated well-filled church, on a cold winter night, without a topcoat. You sit down, surrounded on all sides by men or women. Now observe the changes which have taken place. From being in a cold dry atmosphere, moving with a certain velocity, you are now in a warm atmosphere, tolerably moist, which is practically still. You will not sit long before beginning to feel warmer. Why do you feel

warmer? Is it because your body is producing more heat than it was when outside? No; it is because you are losing less heat. How are you losing less heat? Let us consider, first, the loss by radiation. Outside, your heat radiated into the cold atmosphere, but now you are closely surrounded by bodies of the same heat as your own, and so the loss by that channel is practically stopped. Secondly, how does convection act? Outside, the movement of the air deprived you of heat by convection, but now the air is nearly still and warm, so that convection takes very little heat from the body. Thirdly, how about evaporation? The air being moist and warm less water leaves the lungs in the breath, and evaporation from the skin is reduced to a minimum, so that by this channel also your heat loss is lessened. If you continue in the crowded room you perspire profusely, the system becomes burdened, the heart's action is laboured, and while some may faint, others have a headache. What can you do to relieve the system? You may by fanning yourselves, *i.e.*, by causing a large amount of air to pass over the uncovered or lightly-covered parts of your bodies, increase your heat loss, and so cool yourselves, by increased convection and evaporation. The time, however, arrives when you must go home, and you step out of the warm room into the cold atmosphere, your clothes being damp and your skins bathed in a profuse perspiration. What a change must the system then undergo! It has been endeavouring to increase your heat loss, now it must stop all heat loss as far as possible. As you enter the cold air your damp clothes conduct the heat more quickly to the surface, so that radiation will be actively at work. Convection, by the cold rapidly-moving air, will carry the heat quickly from your bodies; and evaporation will also be going on, so that every possible channel by which heat can be lost, is, from being shut the minute before, widely open, and so you begin to feel chilly. The nerves, in endeavouring to stop your heat loss, cause the blood-vessels of the skin to contract, and so the blood is sent to the interior of the body, where the sudden change is apt to cause mischief to some important organ, giving rise to inflammation of the lungs, bronchitis, or to whatever disease you may be most subject. Those who had most of the body uncovered would run the greatest risk, and those with linen or cotton next to the skin would run more risk than those who wore flannels, because flannel is a worse conductor, and evaporation takes place more slowly from it than from linen or cotton.

In a case such as I have supposed, a warm topcoat, put on just as you were about to leave the meeting, might have prevented disease; or, by remaining in the room until you became cooler,

the system would gradually have accommodated itself to the altered atmosphere, and the chill would have been obviated.

With regard to the use of flannel, I will give you an extract from an article by Dr. Combe, of Edinburgh, written about 1840. He says: "The advantages of flannel as a preservative from disease, in warm as well as in cold climates, are now so well understood that in the army and navy its use is cogently and with great propriety insisted on. Sir George Ballingall, in his valuable 'Lectures on Military Surgery,' has some very judicious remarks on the influence of warm clothing in preserving the health of soldiers. After adducing the testimony of Sir James McGregor to show that in the Peninsula the best clothed regiments were generally the most healthy, Sir George mentions that, when in India, he had himself a striking proof of the utility of flannel in checking the progress of a most aggravated form of dysentery in the Second Battalion of the Royals. Captain Murray, also, late of H.M.S. Valorous, told me that he was so strongly impressed, from former experience, with a sense of the efficacy of the protection afforded by the constant use of flannel next the skin, that when, on his arrival in England in December, 1823, after two years' service among the icebergs on the coast of Labrador, the ship was ordered to sail immediately for the West Indies, he directed the purser to draw two extra flannel shirts and pairs of drawers for each man, and instituted a regular daily inspection to see that they were worn. These precautions were followed by the happiest results. He proceeded to his station with a crew of 150 men, visited almost every island in the West Indies and many of the ports in the Gulf of Mexico, and, notwithstanding the sudden transition from extreme climates, returned to England without the loss of a single man or having any sick on board on his arrival. It would be going too far to ascribe this excellent state of health solely to the use of flannel, but there can be little doubt that this was an important element in Captain Murray's success. When in command of the Recruit guard brig, which lay about nine weeks at Vera Cruz, the same means preserved the health of his crew when the other ships of war anchored around him lost from twenty to fifty men each. Facts like these are truly instructive by proving that man possesses much power of protecting himself from injury when he has received the necessary instruction, and chooses to adapt his conduct to the circumstances in which he is placed."

Having considered then, very generally, the most suitable underclothing for the inhabitants of these islands, what can be said generally as to the rest of the clothing? That must vary (1) according to the season and state of the atmosphere; (2) according

to the active or passive state as well as the age of the wearer; and (3) in every case it ought to be as light in weight as possible, and in no way interfere with the motions of the body.

1. As to the season and state of the atmosphere. If the summer is hot, with flannel next to the skin we can do with light upper clothing, both as regards weight and colour; but if the summer be cold, damp, and without sunshine, such as that which we have just experienced, thick flannels and moderately thick upper clothing are necessary to preserve health; so that we cannot dress by any hard and fast rule, even as regards the seasons, and what we ought to wear becomes quite a study. In winter the heaviest woven flannels are necessary next to the skin, and for upper clothing we must have a material which is well calculated to preserve our heat. Against changes in the atmosphere, in any season, from day to day, a topcoat or cloak must be our defence, and by its judicious use, being thin in summer and thick in winter, much illness may be avoided.

2. Clothing must vary according to the active or passive state of the wearer. The clothing of a man working hard at some manual labour, and earning his bread by the sweat of his brow, must differ from that worn by the business man, who sits all day in his warehouse, earning what he can by the sweat of his brain. The one manufactures more heat than he requires, even in winter, while the other can hardly keep himself comfortable with a good fire and the warmest clothes. Again, he who walks must be clothed differently from him who drives, and she who dances from him who pipes; but when the walker stands, and the dancer ceases to dance, they should have extra covering to prevent a chill. Age, too, must be considered in speaking of clothing, for, although it is important at all ages, the very young and the very old require to be especially protected against cold.

3. As to the form of our upper clothing. It should sit comfortably on the body, all weight being suspended from the shoulders alone, and whoever feels any oppression from their clothes, even on the shoulders, may rest assured that they are either improperly clothed or the subjects of some unsuspected disease.

This being a popular and not a purely scientific lecture I now proceed to consider very briefly the dress of (1) the child, (2) the woman, and (3) the man, as it is, and as it ought to be.

1. As to the child's dress. At present, as soon as born, it is dressed in a variety of articles which I need not separately mention, suffice it to say that, when its toilet is complete, it very much resembles a bundle of clothes, and no one would suspect, were it not for a small round protrusion, that the beautiful outline of the infant had been so strangely transformed. In this way the

infant is dressed until the period is reached when it must be "shortened." What this process called "shortening" indicates I have never been able to find out, but it is generally accomplished about the end of the third month, when vaccination ought to be performed, and just at a time when the child requires the greatest possible care. This process consists in discarding the white dress, with long skirt and sleeves, for one much shorter and without sleeves. A pair of woollen shoes cover the feet, and these are frequently the only woollen articles covering properly any part of the skin. Closely pinned round the body, from the loins to the upper part of the thighs, is, as a rule, a cotton cloth, above which the clothes are so loose that every breath of wind must find its way all over the remaining surface of the skin. When the child begins to walk the dress is *again* shortened, the cotton cloth is discarded, and socks, reaching half-way up to the knee, and shoes, are put on the feet. Clothed in such a way, the little boy or girl endeavours to live until about the age of ten, when the dress is fashioned pretty much after the style of that of men and women.

Now that, I believe, is a pretty correct account of the way in which the great bulk of children are dressed. It is the way in which they have been dressed from time immemorial; but I hope that as Sanitary Science grows older, and as the laws of health and the causes of disease, by more study, become better known, little children will be dressed with a view to the preservation of health, and not merely to please the eye of a fond parent. Without attempting to say what garments ought to be retained, and what done away with, I would like to impress upon you the necessity of clothing the child in flannel garments, which should fit the body as closely, and at the same time as comfortably, as your ingenuity can devise; and if some cotton must be on any part of the body, let it be surrounded by flannel.

Who, with a knowledge of the functions of the skin, can look upon helpless children, still unable to lisp their wants, clothed as we see them, sitting on the doorstep, rolling on the parapet, or carried about by their mothers, without a shudder, and a strong desire to speak a word, for those who cannot speak for themselves. By an entire change in the clothing of infants our dreadful infant mortality might be reduced, and I cannot conceive a subject upon which any woman could exercise her inventive powers that will be more plentiful in beneficial results, or confer upon her a more lasting fame.

2. I come now to consider the clothing of woman. I must confess that in approaching this part of my subject I feel as if I were leading a forlorn hope. Mothers, I fancy, may dress their

children according to the dictates of science, but who can hope that the women themselves will not dress according to the fashion?

What a power fashion is! And its changes being so frequent we notice it most amongst women, who seem to derive peculiar pleasure from variety of costume; as if, when the Creator, for the sins of our first parents, ordained that they should need clothing, had imparted to the original offender, and all her female posterity, a taste which converted the penalty into a boon. Women must be in the fashion!

I believe that merchandise is carried over the hills in India on the backs of elephants, and to save drivers, and keep the animals in order, the second one is fastened by his trunk to the leader's tail, the third one is fastened in the same way to the second, and so on along the whole line. When ready to start, the driver has merely to mind the leader, and by keeping him moving all the rest are obliged to follow, being led by the nose.

Again, I am told that the camels in Egypt cannot be got to move well without a leader, and so a donkey is frequently selected to lead them. Thus, in that country, one may see a whole line of camels quietly following an ass. That must be a strange sight to a European; but it would be quite as strange if we could see the woman who leads the fashion followed by her disciples, representing the fashions which have prevailed during the present century. They would not be, like the elephants, led by the noses by a visible bond—they would more resemble the camels who follow the ass, merely because it leads.

Fashion rules all classes of society. It begins at Court, and gradually descends to the meanest of Her Majesty's subjects, so that, in these islands, its sway is universal. Its influence for good or evil is incalculable, and therefore if the leader were guided by a knowledge of the laws of health, and made every fashion subservient to them, how much more worthy would she be of the homage which is now unthinkingly paid to her. Unfortunately, fashion rarely approaches the skin. It, as a rule, merely deals with the uppermost garments, and what may be called their appendages. The underclothing has been little, if at all, affected by the violent commotions which we have witnessed on the surface. As things are at present, the time seems opportune to suggest some improvement in woman's clothing. It looks as if an endeavour were now being made to divest the female of those coverings which have been from earliest times associated with her, and in their stead to wear garments which hitherto have not been avowedly worn by any woman. The lady has become so like the gentleman, that in *Punch*, a week or two ago, I saw a sketch of a

ladies' waiting-room, where an elderly lady, called Mrs. Broadrib, was accosting a young lady dressed in the fashion, and asking her, in very indignant tones, if *he* was aware that that was a *ladies'* waiting-room. The old lady had made a mistake, but it was a very pardonable one, so strongly did the back view of the lady resemble that of a gentleman.

But, as to the way in which the underclothing of women is arranged, I desire to point out how it is objectionable with a view to the enjoyment of health. First, then, it is objectionable in so far as the whole body is not covered closely by comfortably-fitting flannels. Next, there are the stays, which encircle the body, and are frequently laced more tightly than they ought to be. Then there is a great weight of petticoats bound round above the stays, causing weight and pressure where least of all they should be felt.

First, as to the stays, I have little doubt they were first worn, to improve the figure, by some obese old lady of fashion, and from her, and such as she, they came to be worn by all women, that they might possess a figure which was considered genteel. This can easily be understood when we remember that the female figure, with and without stays, is very different in appearance. So different is it that stays are considered necessary to hide its outline. In fact, our ideas as to the female figure are so perverted that when we see it in its greatest perfection—modestly clothed without the mask of the stays—it is to many people anything but agreeable to look upon. The female figure has always been considered the most beautiful of nature's works. As one poet has it—

> "Her 'prentice hand she tried on man,
> And then she made the lasses, O!"

But fashion would improve upon nature. The idea which fashion has engendered of the figure which it is proper for women to present is an entirely false one, and, being so, cannot please those who love the truth and hate deception. Much of woman's attire, I suppose, is got up to please and, may-be, captivate man, but how shortlived must be the happiness which depends upon dress. Unless woman has a healthy body, and a well-balanced and attractive mind, any victory she may achieve by dress will, I fear, prove a very questionable success; and, if we may believe Byron, there is something more likely to captivate man than either dress or beauty. Hear what he says to "Marion:"—

> "Marion, adieu! Oh, prythee, slight not
> This warning, though it may delight not—
> And, lest my precepts be displeasing
> To those who think remonstrance teasing,
> At once I'll tell thee our opinion
> Concerning woman's soft dominion.

Howe'er we gaze with admiration
On eyes of blue or lips carnation—
Howe'er the flowing locks attract us,
Howe'er those beauties may distract us—
Still fickle, we are prone to rove—
These cannot fix our souls to love.
It is not too severe a stricture
To say they form a pretty picture;
But wouldst thou see the chain
Which binds us in your humble train,
To hail you queens of all creation,
Know, in a word, 'tis *Animation!*"

There is a depth of meaning in the word animation. It refers not only to the mind, but also to the body. And who can imagine any figure being pleasantly or comfortably animated, dressed as the bulk of women are at the present day?

Whilst speaking of dress and fashion, I may take this opportunity of calling attention to the great distress caused by the fashion of mourning. The poorest of the poor will wear mourning when a relative dies, and the expense thus incurred reduces many families to the direst extremity. All of us would do well to remember Hamlet's words as to mourning:—

"'Tis not alone my inky cloak, good mother,
Nor customary suits of solemn black,
Nor windy inspiration of forced breath—
No, nor the fruitful river of the eye,
Nor the dejected 'haviour of the visage,
Together with all forms, moods, shows of grief,
That can denote me truly: these, indeed, seem,
For they are actions that a man might play;
But I have that within which passeth show—
These but the trappings and the suits of woe."

Let those, then, endeavour to alter this costly and barbarous fashion whose example is likely to be followed, and by-and-by poor people will think it no want of respect to the memory of their dead relations to go abroad in their ordinary every-day clothes. Let us mourn in a way which "passeth show," and not in any way which "a man might play." The experiment has been tried and found to act admirably by the Society of Friends, and society in general would do well to follow such a good example.

But to return to our subject, to be without stays was to be out of the fashion, and so stays became an important part of the woman's underclothing. If, then, I am correct in supposing that stays were first used by some whose figures were supposed to require them, and so came to be adopted universally as a fashion, and if further I can show that they are the cause of much discomfort, are prejudicial to health, and can be dispensed with by the

great bulk of women with advantage, I hope that all who value their health, and consequently their happiness, will put them off. I have to show how they are prejudicial to health. From inquiry I find that, on an average, the woman whose waist measures, say, 26 inches in circumference, wears stays whose circumference is 22 inches. Thus the circumference of the body is reduced four inches by the stays. Now to allow such a reduction important organs must be pressed upon. Those which can be displaced upwards or downwards will ascend or descend, and those which are more fixed must be compressed. I shall never forget seeing, in the dissecting rooms at the University of Edinburgh, the liver of a woman deeply indented by the ribs, which indentations, the Professor told us, had been caused by tight-lacing. That fact, I hope, is sufficient to satisfy you that the liver can be seriously damaged by the use of stays.

That the lungs and heart can be injured must be evident to all, because by compression of the chest their movements must be interfered with; and whatever interferes with the free action of any organ is hurtful. Again, stays, with the petticoats fastened over them, hanging from the loins, must displace the important organs in the pelvis; and so, from a cause little suspected, and seldom thought of, the woman's life may become a burden to herself, while she is a source of constant anxiety to her friends. I have been informed, on good authority, that some married women lace to such an extent that it is nothing short of murder, if not of themselves, of what might have lived to be their children. If I have been correctly informed, you will see that women who would not knowingly commit any sin are unconsciously breaking the Sixth Commandment. Seeing, then, that by stays such mischief can be effected, women ought to endeavour to dispense with them altogether.

As to the discomfort from the weight of petticoats round the body, over the stays, I need only appeal to the testimony of any woman who knows what a relief it is to be without them. As to their injurious influence upon health, besides displacing important pelvic organs noticed before, their mere weight, acting where it does, is a continuous drag on the spinal column, and so the quantity and weight of petticoats ought to be reduced as much as possible with a view to the preservation of health. Petticoats are worn to preserve the heat of the body, *i.e.*, to make up for the want of proper flannels; but by wearing suitable flannel dresses, covering the body from the ankles to near the wrists, such as are made for women, petticoats in so far as warmth is concerned, may be entirely dispensed with; and if any are worn, they ought to be

suspended by what may be called braces from the shoulder. To show that it is practicable for woman so to dress, I am fortunate in being able to read to you the experience of a most intelligent member of the sex, who, when well advanced in years, began to dress in the way I have recommended. She says :—

"You expressed a wish to know my experience or sensations on laying aside what is now a corset, but which our grandmothers knew as stays. But you must remember that the change of dress I made was not simply laying them aside, it was at the same time removing all the weight which was borne by the waist and giving it to be borne by the shoulders. Well, the first sensation was of extreme discomfort; I had never been addicted to tight-lacing, and should have resented being accused of it, and yet no sooner were the stays removed than I found everything else far too tight. Pressure, which the stays had prevented me from noticing, without their intervention became intolerable, and I had to let out the bands confining all garments at the waist till I could move easily in them. This done, the relief was wonderful [you don't know how bravely and heroically women bear burdens imposed by fashion or custom]; in fact I never could have believed so small a change in dress could have produced such rest. Breathing seemed changed, I don't exactly understand how, but as if the breathing apparatus was no longer confined to the lungs, as if the whole body shared in it. Walking became a pleasure. Where the weight had gone was a puzzle, for the shoulders were not sensible of it, while the free play of the lower limbs was simply delightful. Of course, the support in front being gone, it seemed as if one was glad to lean back in one's chair; stooping seemed a pain now, instead of a relief; and the strap across the shoulders connecting the shoulder straps seemed a necessity. Pain in the lower part of the back, from which I used to suffer, has gone. I don't know how. I can run upstairs like a child without being out of breath, and I can stoop without inconvenience."

From what I have previously said, and after such testimony as that, I think you will admit that I have proved the way in which women dress at the present day to be the cause of much discomfort, suffering, disease, and even death; and further, that woman's dress can be so arranged, that it is comfortable, and able to preserve health, without any bad effect whatever. I must not leave the subject of woman's clothing without entering a protest against fashion interfering with the foot, so as to affect the equilibrium of the body by putting high heels to the boots, which injure the spine and destroy the calf of the leg. The soles of the boots should be thick and warm, since it is through the soles of

our feet, and through them alone, that we lose heat by conduction, as we stand or walk. And just as the feet must be kept warm the head should be cool, and not loaded with any foreign substance except the hat or bonnet. Mr. Buchan, secretary to the Scottish Meteorological Society, in a paper on some of the more striking relations of Meteorology to Public Health, says: "During December, January, and February, the mortality among females rose 11·2 per cent above the average; whereas among males it only rose to 7·8 per cent. From the incompleteness of the registration returns, however, it is impossible to say how much of the excess, during the coldest months of the year, is due to sex, how much to occupation, and how much to their boots or other fashions." So that you see we may yet be able, by improved registration returns, to tell how many women die martyrs to fashion.

And now, with a feeling akin to that experienced on removing a pair of tightly-laced stays, I take leave of woman's dress, and come next to consider that of man.

3. Man's clothing is much more simple than that of woman, and need not detain us long. Man, as a rule, carries out our first great principle in clothing by wearing flannel vest and drawers next to the skin; and an upper shirt, with a suit of clothes, complete his dress. The only faults I can find with man's dress are (1) the opening in the waistcoat to show the shirt, and (2) the way in which the coat is left open behind. The first exposes the chest and throat unduly, and the latter permits the loins, when we sit, to be entirely without protection from the coat, which may explain the frequent occurrence of lumbago amongst men. The tall silk hat, which is looked upon by some as a mark of respectability, and which the members of some professions are in the habit of wearing, is not only uncomfortable but, being made of air-proof material, must be injurious to the scalp. Soft hats, made of felt or some other material which allows free ventilation, are the most comfortable and healthful that can be worn, and it would be well for the community if silk hats could be done away with.

One garment yet remains to be mentioned, namely, the bed. Seeing that we spend such a large portion of our time in bed, it is to us a most important article. By sleep our bodies are refreshed, and unless we have comfortable beds our health is likely to suffer. During the night, when lying asleep, our temperature is lower than in the day when awake, and so we require more clothing to keep us warm. If we sleep in flannels, they should not be those worn during the day. The bed must be made of some bad-conducting material, such as hair, feathers, or straw.

I must now say a word as to clothes conveying disease. Some

diseases are so infectious that the infection can be carried by a healthy person in the clothes and communicated to a third party. In this way diseases are often caught in omnibuses and railway carriages. Again, clothes sent from one place to another may convey disease a great distance. It was in this way that Eyam, in Derbyshire, was nearly depopulated by the plague, the infection of which was conveyed in some cloth sent from London, where the plague was raging, to a tailor in that isolated and picturesque village. I have known of a dressmaker making dresses in her house where smallpox was, and sending the dresses to their respective owners, who, no doubt, if at all susceptible, would contract that loathsome disease. Disease, too, may be got through the washerwoman mixing infected with uninfected clothes, so that all become infected.

And now a few words as to the necessary change of clothing. This must depend on the habits of the individual; but however much any one may wash, the underclothing ought to be changed every week. The flannels absorb the perspiration, and if the skin be not regularly washed the flannel becomes full of refuse matter, and at the same time loses its power of retaining heat. Those who wear their underclothing too long, and do not wash their bodies frequently, become walking nuisances, continually evolving noxious effluvia. When any number of such individuals meet in a room, the atmosphere is quickly rendered unpleasant to the sense of smell—and when air can be smelled it is bad indeed. This points to the necessity of frequently washing the whole body; but I am well aware what a difficulty that is in this neighbourhood. And yet how easy might ample provision be made. Every mill has always plenty of warm water at hand, and at very little expense two baths might be inclosed, one for the males and the other for the females employed. With such baths at each mill, and central corporation baths, the population would have a chance of knowing what a luxury a clean skin is; and when clean they would perhaps be able to regard with comfort and appreciation any exhibition of art that might be provided for their education or amusement. Cleanliness is one of the levers by which the masses are to be elevated, and if the means of cleaning themselves is not within their reach they must remain dirty and degraded. Dirty men and women cannot regard anything in the same light as they would do if they were clean. If their bodies were clean, they would pay more attention to their clothes; and attracted perhaps by the title of this lecture, they might be induced to read it, and so learn something of the Philosophy of Clothes.